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RESPONSE OF 9-YEAR-OLD McKEE HYBRID POPLAR TO GIBBERELLIC ACID

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SUMMARY

1. Nine-year-old McKee hybrid poplar trees 32.2 to 46.5 feet in height and 3.33 to 8.94 inches in diameter (d.b.h.) were treated with 0, 10, 30, 60, 100, and 1,000 ppm of gibberellic acid.

2. One hundred ml. of the potassium salt of gibberellic acid solution was introduced directly into the vascular system at the base of the trees. The applications were made May 1, June 1, July 1, and September 1, 1957.

3. The juvenile leaves of the trees treated with 60, 100, and 1,000 ppm gibberellic acid exhibited toxicity in that the leaves recurved and wilted. The higher concentration produced the more adverse effect.

4. There were no significant differences between treatments during the normal growing season with regard to height, diameter, and duration of growth.

5. Dormancy was broken after September 1 by 60, 100, and 1,000 ppm treatments. Dormancy was more completely broken at the higher concentrations.

6. This study suggests that gibberellic acid is readily translocated throughout the vascular system.

7. Apparently a lower concentration of gibberellic acid will break fall dormancy than that which is required to alter the activity of the cambial and apical meristematic tissue during the normal growing season.

LITERATURE CITED

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ON THE COVER

Fig. 1.—Method of applying gibberellic acid solution to trees.

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INTRODUCTION

The use of gibberellic acid as a plant growth regulator has become recognized as having great potential in the botanical fields as reported by Wittwer and Bukovac (3).

It has been reported by Marth et al. (1) and Nelson (2) that gibberellic acid has greatly increased stem elongation in forest tree seedlings. The increase in new growth in height of the treated plants over the untreated plants ranged from 57 to 353 percent.

The present study was designed to observe the effects of gibberellic acid upon the diameter as well as terminal elongation of a forest type tree.

METHODS

A plot of 9-year-old McKee hybrid poplars, started from cuttings, was treated with a solution of the potassium salt of gibberellic acid. The gibberellic acid solution was introduced directly into the xylem at concentrations of 0, 10, 30, 60, 100 and 1,000 parts per million.

The trees in the experiment ranged in diameter from 3.33 to 8.94 inches at d.b.h. and in height from 32.2 to 46.5 feet.

The five experimental plots were located on a northern exposed slope, well drained and adjacent to one another.

In each of the five replications a single trees was treated at each concentration by introducing 100 ml. of the solution directly into the xylem. A hole one-half inch in diameter and approximately one-inch deep was bored into the north side of the tree at one foot above the ground level. The solution was introduced from an inverted erlenmyer flask using stoppers and bent tubes to allow for the movement of the solution into the vascular system of the trees (Fig. 1, on the cover). Initial treatments were made on May 1, 1957 and repeated on June 1, July 1, and September 1, 1957.

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RESULTS

The buds of the trees were swollen at the time of the first application and there was no difference in the time of the appearance of the new leaves between the treatments. Two weeks after the initial treatment, it was observed that the newly formed leaves on the trees of the 1,000 ppm gibberellic acid series were recurved. There was also firing or wilting of the fully expanded leaves which occurred sporadically throughout the crown. The symptoms of toxicity disappeared within one week after these observations and did not recur during the experiment. The firing or wilting was noticeable in the 100 ppm series in the lower two-thirds of the crown, but recurving of the juvenile leaves did not occur. Firing of the leaves on the lower half of the crown in the 60 ppm series occurred on only one tree.

Monthly measurements of the diameter showed that the trees grew during the months of May, June, and July. There was no effect of the treatments on extending the season of growth.

At the time of the September 1 application the buds on the trees of all treatments were well formed and many of the old leaves had abscissed.

All of the trees in the 1,000 ppm and 100 ppm series broke lateral and terminal bud dormancy within two weeks after the September 1 treatment and only one tree broke dormancy in the 60 ppm series. During this period all of the other treated series as well as the controls remained dormant. The trees of the 1,000 ppm series broke dormancy earlier than the trees of the 100 ppm or the 60 ppm series and the trees of the 100 ppm earlier than those of the 60 ppm series. Likewise at the higher concentrations the trees leafed out more fully and the height growth was greater (Fig. 2, 3, and 4). The trees that broke dormancy in September continued to grow until heavily frosted on November 9. As a result of frost damage the new growth was killed. This new growth in the 1,000 ppm series gave the trees a willowy appearance (Fig. 3).

Although height and lateral growth occurred there was no change in the diameters of the trees during the September 1 to November 9 period.

An analysis of covariance showed that the changes in height of the trees were not associated with the initial heights, but that the changes in height were associated with initial diameters.

Further analysis showed that the changes in diameters were associated with the initial diameters.

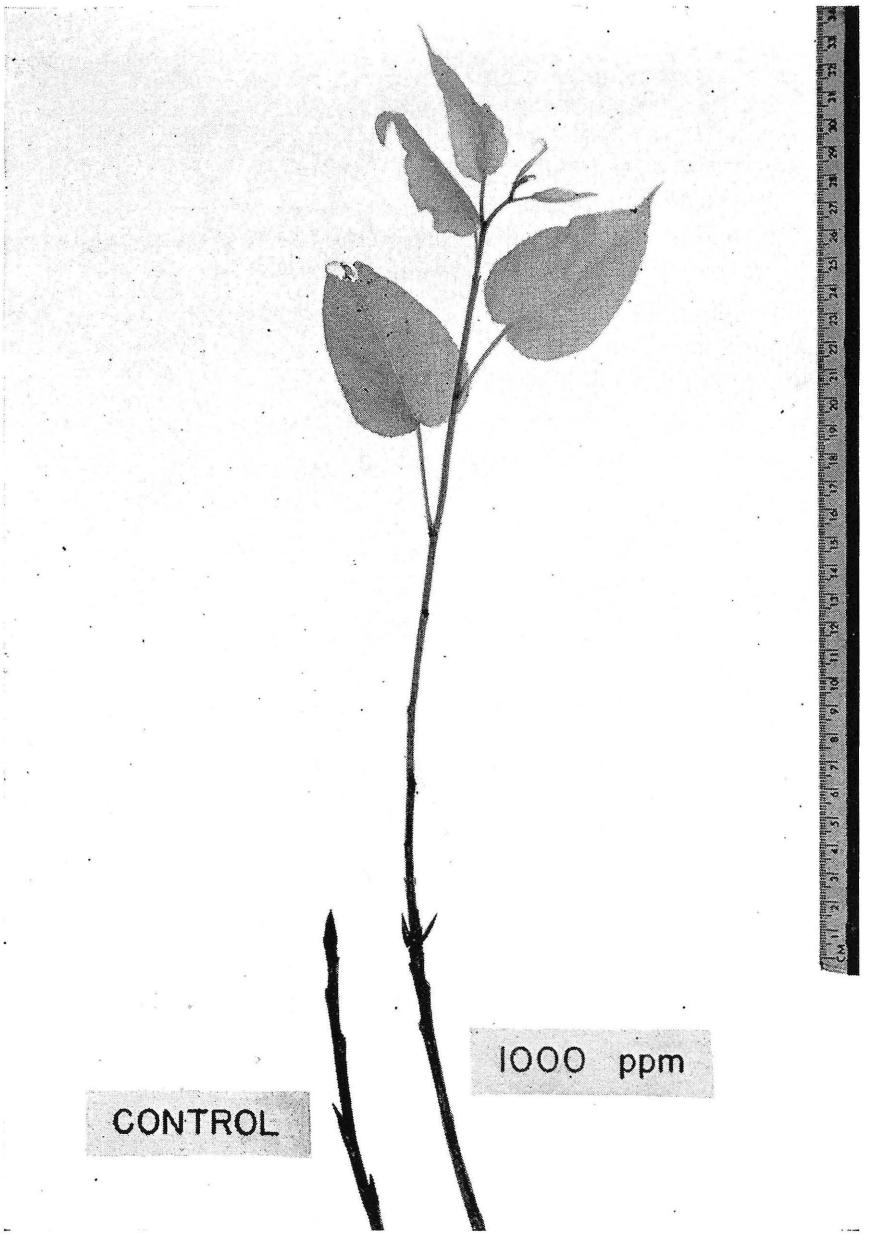

Fig. 2.—Response and growth of a lateral branch to gibberellic acid. Treatment was made on Sept. 5 and branches photographed Sept. 19, 1957.

Since both the changes in height and diameter are associated with the initial diameter an analysis of covariance was performed on this basis.

The analysis revealed that the growth in height and diameter did not vary between the treated and non-treated trees during the period of May 2 to September 5 (Fig. 4).

The average height growth ranged from 4.4 to 6.9 feet in all series during the period of May 1 to September 1 (Fig. 4).

From September 1 to November 9 the average height increment in the 60 ppm series was 0.10 feet; in the 100 ppm series 1.10 feet; and in the 1,000 ppm series 3.62 feet (Fig. 4).

The average diameter growth for the season ranged from 0.31 to 0.52 inches in all series.

Fig. 3.—Appearance of terminal portions of trees on Sept. 19, 1957. Center tree: dormancy broken and new growth in 1,000 ppm series. Right tree: control, no new growth and tree remained dormant.

DISCUSSION

It is evident that the treatments imposed upon the trees did not have an effect on the height, diameter, or extension of the actively growing period during the normal growing season. This may have been due either to too low a concentration of gibberellic acid or to the fact that the gibberellic acid became inactivated prior to reaching the apical regions of the main stem.

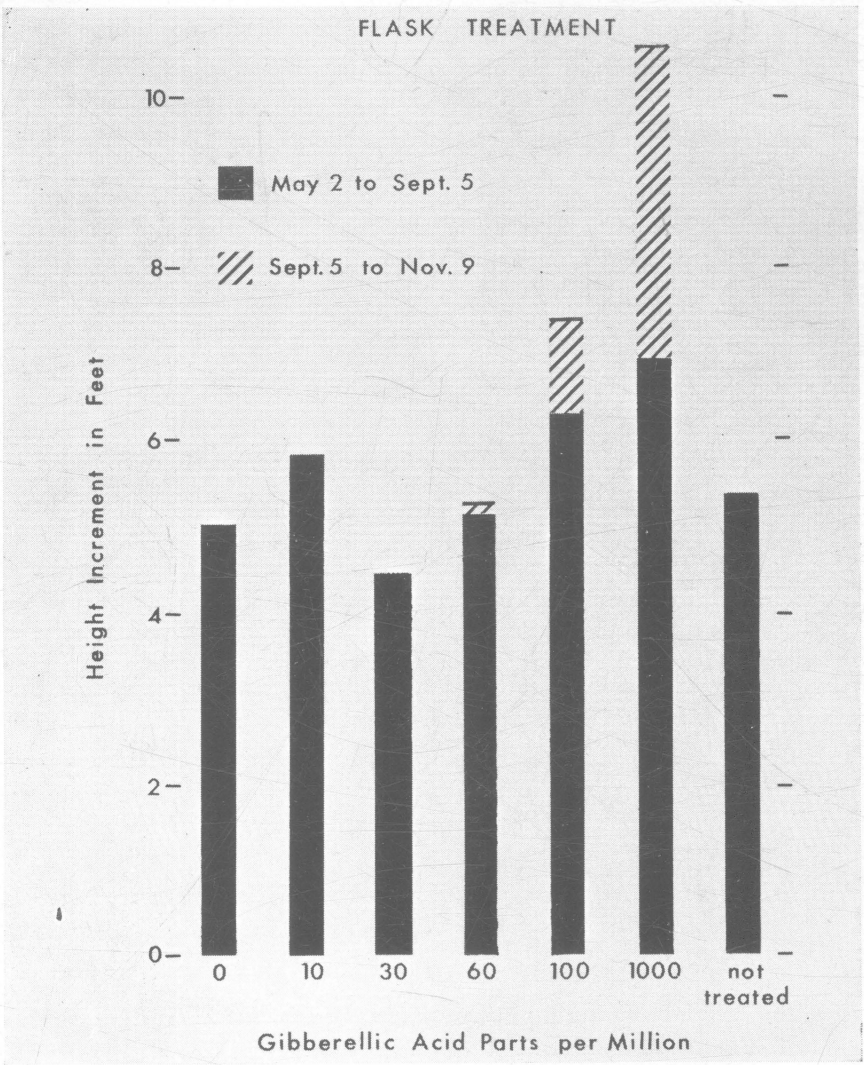

Fig. 4.—Average height growth of 9-year-old McKee hybrid poplar.

The translocation of the gibberellic acid is evidenced by the fact that in the initial applications of the 60, 100, and 1,000 ppm series, distortion and wilting of the juvenile leaves occurred sporadically throughout the trees. The fact that the injury occurred at higher positions in the crown at the higher concentrations and progressively lower at lower concentrations indicates that probably the acid was reaching the terminal portions of the crown at reduced concentration. This could account for the lack of differences in height growth during the normal growing season.

All of the trees irrespective of treatment, appeared to become dormant, as indicated by the cessation of growth, formation of terminal buds, and leaf fall by the first of September.

The most striking response in this experiment was that of breaking dormancy in the trees of the 60, 100, and 1,000 ppm series in September.

Again, at the higher concentration the response of the trees was more pronounced than at the lower concentrations. The indications are that the amount of gibberellic acid required to break fall dormancy is less than that required to stimulate lateral and vertical growth in McKee hybrid trees under the conditions of this experiment.

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